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Title: Direct Dimethyl Ether High Temperature Fuel Cells

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Abstract

Dimethyl ether (DME) is an emerging renewable fuel, with increasing annual production. It has already found widespread use as town gas, primarily in China, but has also been demonstrated as an excellent diesel substitute. With the expected availability and benign properties, DME could advantageously be used as an alternative to methanol in fuel cells, e.g. to power on-board electronic devices in trucks utilizing the same fuel as the engine. The limitations of direct DME fuel cell are the same as for direct methanol fuel cells (DMFCs) – slow kinetics and large degree of fuel crossover, when compared to traditional hydrogen fed cells. Additionally, DME is a gas at ambient conditions with low solubility in water, which is also necessary for conversion of the fuel. In conventional low temperature Nafion-based fuel cells DME-water mixture would separate in two phases, further limiting the performance. Using phosphoric acid doped polybenzimidazole (PBI) membranes it is possible to operate at temperatures up to 200 °C, avoiding phase separation problems by supplying the DME-water mixture as vapour and providing additional energy to overcome the kinetic barriers.

It has previously been shown that it is indeed possible to oxidise dimethyl ether directly in a high temperature proton exchange membrane fuel cell (HT PEMFC) with performances close to DMFC at the same conditions. The presented study gives insights on the effect of operating conditions and cell components composition on performance and durability of direct DME HT-PEMFC. The highest obtained peak power density was 79 mW/cm² at 200 °C and ambient pressure with air as oxidant.

Biography

Anton Vassiliev holds B.Sc degree in Applied Chemistry in 2008 and M.Sc degree in Advanced and Applied Chemistry in 2010 from the Department of Chemistry, Technical University of Denmark with research topics in the renewable energy field. He has submitted his Ph.D. thesis on High Temperature PEM Fuel Cells and Organic Fuels in 2014 at the Department of Energy Conversion and Storage, Technical University of Denmark. Anton Vassiliev has a number of publications and conference contributions on the topic of Direct Dimethyl Ether High Temperature Polymer Electrolyte Membrane Fuel Cells. Currently his work is focused on optimization of production processes, component testing and development of testing equipment and techniques for HT-PEMFCs.

Recent publications:

“A Direct DME High Temperature PEM Fuel Cell”, Vassiliev, Anton; Jensen, Jens Oluf; Li, Qingfeng; Pan, Chao; Cleemann, Lars Nilausen; Steenberg, T.; Bjerrum, Niels, E C S Transactions, Vol. 50, 2012.

“Direct dimethyl ether fueling of a high temperature polymer fuel cell”, Jensen, Jens Oluf; Vassiliev, Anton; Olsen, M.I.; Li, Qingfeng; Pan, Chao; Cleemann, Lars Nilausen; Steenberg, Thomas; Hjuler, Hans Aage; Bjerrum, N.J., Journal of Power Sources, Vol. 211, 2012, p. 173-176.